

# CHRONOGRAPH TIMEPIECE HAVING CALENDAR MECHANISM

## BACKGROUND OF THE INVENTION

### Field of the Invention:

The present invention relates to a chronograph timepiece having a calendar mechanism. Particularly, the invention relates to a chronograph timepiece constituted such that "hour", "minute" and "second" are measured and respective results of measuring chronograph are indicated by a chronograph hour hand, a chronograph minute hand and a chronograph second hand and calendar is indicated by a date indicator.

### Description of the Prior Art:

(1) A chronograph timepiece of a first type of a prior art

(1.1) Surface train wheel

In reference to Fig. 36 through Fig. 41, in a chronograph timepiece of a first type of a prior art, a movement (machine body including drive portion) 800 comprises a base unit 801 including a surface train wheel, a back train wheel, a switching apparatus, a hand setting apparatus, an automatic winding apparatus and/or a hand winding apparatus and the like and a chronograph unit 900 including a chronograph mechanism, a calendar mechanism and the like. The base unit 801 includes a main plate 802 constituting a base plate of the movement 800, a barrel complete 808 provided to the main plate 802 rotatably

and movably in an axis line direction, a surface train wheel rotatably provided to the main plate 802, a barrel bridge (not illustrated), a train wheel bridge (not illustrated), a balance bridge (not illustrated), an escapement mechanism (escapement wheel & pinion, pallet fork) (not illustrated), and a speed control mechanism (balance with hairspring) (not illustrated).

The surface train wheel includes a barrel complete (not illustrated), a center wheel & pinion (not illustrated), a third wheel & pinion 836 and a second wheel & pinion 838. A main spring (not illustrated) is arranged in the barrel complete to constitute a power source of the chronograph timepiece. The center wheel & pinion is rotated by rotation of the barrel complete. The third wheel & pinion 836 is rotated by rotation of the center wheel & pinion. The third wheel & pinion 836 includes a third pinion 836b, a third wheel (not illustrated) and a third transmission pinion 836d. A minute driving wheel & pinion 832 includes a cannon pinion 832b, a minute driving wheel 832c and a second cannon pinion 832d. The third pinion 836b is brought in mesh with the minute driving wheel 832c. The minute driving wheel & pinion 832 is rotated by rotation of the third wheel & pinion 836. A minute wheel & pinion (not illustrated) is rotated by rotation of the cannon pinion 832b. An hour wheel 848 is rotated by rotation of the minute wheel. The second wheel & pinion 840 is rotated by rotation of the third wheel & pinion 836. The second wheel & pinion 840 includes a second second

pinion 840d.

#### (1.2) Chronograph unit

The chronograph unit 900 comprises a chronograph main plate 902 constituting a base plate of a chronograph mechanism, a chronograph bridge 912 arranged to a side of the chronograph main plate 902 having a dial 904 and a chronograph train wheel rotatably provided to the chronograph main plate 902 and the chronograph bridge 912. The movement 800 is arranged with a start/stop button 906 for controlling to operate and stop the chronograph mechanism and a reset button 908 for resetting the chronograph mechanism. The chronograph unit 900 is provided with a coupling lever 914 operated by operating the start/stop button 906.

#### (1.3) Second chronograph mechanism

In reference to Fig. 36 through Fig. 38, an intermediate second chronograph wheel & pinion 920 is arranged rotatably to the chronograph main plate 902 and the chronograph bridge 912. The intermediate second chronograph wheel & pinion 920 includes an intermediate second chronograph wheel shaft 920b, an intermediate second chronograph wheel 920c, an intermediate second chronograph wheel clutch ring 920d, an intermediate second chronograph wheel clutch spring 920e, a second clutch cylinder 920f, a second clutch seat 920g and a second clutch ring 920h.

An intermediate second wheel 850 is rotatably provided to the intermediate second chronograph wheel shaft 920b. The

intermediate second wheel & pinion 850 includes an intermediate second wheel 850b and an intermediate second wheel clutch ring 850c. An intermediate second wheel holding seat 850d is fixed to the intermediate second chronograph wheel shaft 920b to rotatably maintain the intermediate second wheel clutch ring 850c.

The intermediate second wheel 850b is rotated by rotation of the second second pinion 840d. A second indicator 852 is rotated by rotation of the intermediate second wheel 850b. "Second" of current time is indicated by a second hand (small second hand) 854 attached to the second indicator 852.

When the coupling lever 914 is operated by operating the start/stop button 906, by spring force of the intermediate second chronograph wheel clutch spring 920e, the intermediate second chronograph wheel clutch ring 920d is rotated in cooperation with the intermediate second wheel clutch ring 850c. Under the state, the intermediate second chronograph wheel 920c is rotated by rotation of the second second pinion 840d. That is, the intermediate second chronograph wheel clutch ring 920d and the intermediate second wheel clutch ring 850c constitute a "clutch". A second chronograph wheel & pinion 922 is rotated by rotation of the intermediate second chronograph wheel 920c. The second chronograph wheel & pinion 922 includes a second chronograph wheel 922b, a second chronograph wheel shaft 922c, a second heart cam 922d and a stop lever plate 922f. In operating to measure

chronograph, a result of measuring an elapse time period of "second" such as elapse of 1 second is indicated by a chronograph second hand 924 attached to the second chronograph wheel shaft 922c.

#### (1.4) Time indicating mechanism

In reference to Fig. 36, Fig. 37 and Fig. 39, a second minute wheel & pinion 860 is arranged rotatably to the chronograph main plate 902. The second wheel minute wheel & pinion 860 includes a second minute wheel A860a, a second minute wheel B860b and a second minute pinion 860c. The second minute wheel A860a is brought in mesh with the second cannon pinion 832d. The second minute wheel & pinion 860 is rotated by rotation of the minute driving wheel & pinion 832. A second minute driving wheel & pinion 862 is rotated by rotation of the second minute wheel B860b. "Minute" of current time is indicated by a minute hand 864 attached to the second minute driving wheel & pinion 862. A second hour wheel 866 is rotated by rotation of the second minute pinion 860c. "Hour" of current time is indicated by an hour hand 868 attached to the second hour wheel & pinion 866.

#### (1.5) Hour chronograph mechanism

An intermediate hour chronograph wheel & pinion 930 is arranged to be rotated by rotation of the second hour wheel 866. An hour chronograph wheel & pinion 932 is arranged to rotate by rotation of the intermediate hour chronograph wheel & pinion 930. The hour chronograph wheel & pinion 932 includes an hour

chronograph wheel 932b, an hour chronograph wheel shaft 932c, an hour heart cam 932d, an hour chronograph wheel clutch spring 932e, an hour chronograph wheel clutch spring holding seat 932f, an hour chronograph wheel clutch spring receiving seat 932g and an hour chronograph wheel clutch ring 932h. The hour chronograph wheel 932b is rotatably provided to the hour chronograph wheel shaft 932c.

When an hour coupling lever A934 and an hour coupling lever B936 are operated by operating the start/stop button 906, by spring force of the hour chronograph wheel clutch spring 932e, the hour chronograph wheel shaft 932c is rotated in cooperation with the hour chronograph wheel 932b. Under the state, the hour chronograph wheel shaft 932c is rotated by rotation of the intermediate hour chronograph wheel & pinion 930. That is, the hour chronograph wheel clutch ring 932h and the hour chronograph wheel clutch spring 932e constitute a "clutch". In operating to measure chronograph, a result of measuring an elapse time period of "hour" such as elapse of 1 hour is indicated by a chronograph hour hand 938 attached to the hour chronograph wheel shaft 932c.

#### (1.6) Minute chronograph mechanism

In reference to Fig. 36, Fig. 37 and Fig. 40, a minute chronograph wheel & pinion 942 is arranged to rotate by rotation of the third transmission pinion 836d. The minute chronograph wheel & pinion 942 includes a minute chronograph wheel 942b,

a minute chronograph wheel shaft 942c, a minute heart cam 942d, a minute chronograph wheel clutch spring 942e, a minute chronograph wheel clutch spring holding seat 942f, a minute chronograph wheel clutch spring receiving seat 942g and a minute chronograph clutch ring 942h. The minute chronograph wheel 942b is rotatably provided to the minute chronograph wheel shaft 942c.

When a minute coupling lever A944 and a minute coupling lever B946 are operated by operating the start/stop button 906, by spring force of the minute chronograph wheel clutch spring 942e, the minute chronograph wheel shaft 942c is rotated in cooperation with the minute chronograph wheel 942b. Under the state, the minute chronograph wheel shaft 932c is rotated by rotation of the intermediate minute chronograph wheel & pinion 940. That is, the minute chronograph clutch ring 942h and the minute chronograph wheel clutch spring 942e constitute a "clutch". In operating to measure chronograph, a result of measuring an elapse time period of "minute" such as elapse of 1 minute is indicated by a chronograph minute hand 948 attached to the minute chronograph wheel shaft 942c.

#### (1.7) Calendar mechanism

In reference to Fig. 36, Fig. 37 and Fig. 41, an intermediate date indicator driving wheel 870 is rotated by rotation of the hour wheel 848. A date indicator driving wheel 872 is rotated by rotation of the intermediate date indicator driving wheel 870. A date indicator feeding finger 874 is rotated integrally

with the date indicator driving wheel 872. A date wheel 876 having 31 pieces of inner teeth is rotatably arranged to the main plate 802. The date indicator feeding finger 874 can rotate the date wheel 876 by an amount of one tooth per day. A date wheel jumper 878 is provided to restrict a position in the rotational direction of the date wheel 876. A date feeding transmission wheel & pinion 880 is rotatably arranged to the chronograph main plate 902 and the chronograph bridge 912. The date feeding transmission wheel & pinion 880 includes a date feeding transmission wheel A880a, a date feeding transmission wheel B880b and a date feeding transmission wheel shaft 880c. The date feeding transmission wheel A880a is brought in mesh with the date wheel 876.

A second date indicator driving wheel & pinion 882 is provided to rotate by rotation of the date feeding transmission wheel & pinion 880. The second date indicator driving wheel & pinion 882 is rotatably arranged to a second date indicator driving wheel pin 882p fixed to the chronograph main plate 902. The second date indicator driving wheel & pinion 882 includes a second date indicator driving wheel 882b and a second date indicator driving cam 882c. The second date indicator driving wheel 882b is brought in mesh with the date feeding transmission wheel B880b. A date indicator 886 having 31 pieces of inner teeth is rotatably arranged to the chronograph bridge 912. A date jumper 888 is provided to restrict a position in the



rotational direction of the date indicator 886. The second date indicator driving cam 882c can rotate the date indicator 886 by an amount of 1 tooth per day. Current "date" can be indicated in a day window (not illustrated) of the dial by numerals (not illustrated) of "1" through "31" provided at the date indicator 886.

A portion of the date jumper 888 is arranged to a portion of overlap a second indicator 852. A portion of the minute chronograph wheel 942 is arranged to overlap a portion of the date indicator driving wheel 872. A portion of the minute chronograph wheel 942 is arranged to overlap a portion of the intermediate date indicator driving wheel 870. The date wheel jumper 878 is arranged to overlap a portion of the minute chronograph wheel 942. The date wheel 876 is arranged to overlap the date indicator 876.

(2) A chronograph timepiece of a second type of a prior art

A chronograph timepiece of a second type of a prior art, in the mode of measuring a chronograph, includes a chronograph wheel provided rotatably based on rotation of a barrel complete, a minute chronograph train wheel provided to rotate based on rotation of the chronograph wheel and an hour chronograph train wheel provided to rotate based on rotation of the chronograph wheel. In a state in which a chronograph mechanism is not operated, a first coupling lever and a second coupling lever

are brought into contact with an outer peripheral inclined face of a second clutch ring 224 to separate the second clutch ring from an upper face of a wheel of a second wheel & pinion. A second clutch spring and a second clutch ring constitute a first clutch mechanism provided at the chronograph timepiece. An intermediate hour/minute chronograph wheel & pinion (A) is constituted to rotate based on rotation of the chronograph wheel. An intermediate hour/minute chronograph wheel & pinion (B) is rotated based on rotation of the intermediate hour/minute chronograph wheel & pinion (A). The intermediate hour/minute chronograph wheel & pinion (B) penetrates a portion of a main plate. The intermediate hour/minute chronograph wheel & pinion (B) includes a slip mechanism.

An hour chronograph transmission wheel (C) is rotated based on rotation of an intermediate hour/minute chronograph pinion (B). An hour chronograph transmission wheel & pinion (B) is rotated based on rotation of the hour chronograph transmission wheel & pinion (C). An hour chronograph transmission wheel & pinion (A) is rotated based on rotation of the hour chronograph transmission wheel (B). An hour chronograph wheel & pinion is rotated based on rotation of the hour chronograph transmission wheel (A). An hour clutch spring constitutes a second clutch mechanism. An intermediate minute chronograph wheel & pinion is rotated based on rotation of the intermediate hour/minute chronograph pinion (B). A minute chronograph wheel is rotated

based on rotation of the intermediate minute chronograph wheel & pinion. A minute clutch spring constitutes a third clutch mechanism.

A date indicator is rotatably integrated to a second train wheel bridge by a date indicator holder to indicate "date". The date indicator is operated by a calendar feeding mechanism (refer to, for example, JP-A-11-23741).

(3) A chronograph timepiece of a third type of a prior art

According to a chronograph timepiece of a third type of a prior art, in resetting operation, a chronograph hammer is constituted to rotate to be brought into contact with three heart-like members (refer to, for example, Japanese Patent Publication No. 3336041).

However, according to the chronograph timepieces of the prior arts, problems shown below are posed.

(1) A problem of the chronograph timepiece of the first type of the prior art

According to the chronograph timepiece of the first type of the prior art, the chronograph mechanism is arranged between the chronograph main plate and the chronograph bridge and the calendar mechanism is arranged to overlap the chronograph mechanism. That is, a portion of the minute chronograph wheel & pinion is arranged to overlap a portion of the date indicator driving wheel, a portion of the minute chronograph wheel & pinion

is arranged to overlap a portion of the intermediate date indicator driving wheel and the date wheel jumper is arranged to overlap a portion of the minute chronograph wheel & pinion. Further, the chronograph timepiece of the first type of the prior art includes the date indicator and the date wheel and the date indicator is arranged to overlap the date wheel. Therefore, a number of parts constituting the calendar mechanism is large and the calendar mechanism becomes complicated. Therefore, according to the chronograph timepiece of the first type of the prior art, there poses a problem of increasing a thickness of the movement.

(2) A problem of the chronograph timepiece of the second type of the prior art.

According to the chronograph timepiece of the second type of the prior art, the surface train wheel is provided with the clutch mechanism. Further, a number of parts constituting the chronograph mechanism is large and the chronograph mechanism becomes complicated. Therefore, according to the chronograph timepiece of the second type of the prior art, there poses a problem of increasing the thickness of the movement.

(3) A problem of the chronograph timepiece of the third type of the prior art

According to the chronograph timepiece of the third type of the prior art, tolerances of parts of portions at which the chronograph hammer is brought into contact with the heart-like

members are severe and in fabricating the chronograph hammer, there is a necessity of individually adjusting the portions brought into contact with the heart-like members. That is, the chronograph hammer is rotated to be simultaneously brought into contact with the three heart-like members and therefore, it is very difficult to accurately control dimensions and shape of three portions of the chronograph hammer brought into contact with the heart-like members.

#### SUMMARY OF THE INVENTION

It is an object of the invention to realize a chronograph timepiece constituted such that a chronograph mechanism and a calendar mechanism do not overlap each other and having a thin thickness of a movement.

Further, it is another object of the invention to realize a chronograph timepiece having simple structures of a chronograph mechanism and a calendar mechanism.

Further, it is another object of the invention to realize a chronograph timepiece in which fabrication and assembly of a chronograph mechanism are facilitated.

In order to resolve the above-described problem, the invention is constituted to include a base unit having a main plate constituting a base plate of a movement, a surface train wheel rotated based on rotation of a barrel complete and an escapement/speed control apparatus for controlling rotation of

the surface train wheel and having at least one of an automatic winding apparatus and a hand winding apparatus and a chronograph unit having a second indicating mechanism, a second chronograph train wheel, a minute chronograph train wheel, an hour chronograph train wheel and a calendar mechanism in a chronograph timepiece constituting a power source by a main spring provided in the barrel complete and having the calendar mechanism for indicating a date.

The chronograph timepiece of the invention is characterized in that the chronograph unit is arranged on a side of the base unit having a dial, the calendar mechanism includes a date indicator and a date feeding mechanism and the date feeding mechanism is arranged not to overlap any one of the second indicating mechanism, the second chronograph train wheel, the minute chronograph train wheel and the hour chronograph train wheel. By the constitution, a small-sized thin type chronograph timepiece can be realized.

It is preferable that the chronograph timepiece of the invention includes a date correcting mechanism for correcting the date indicator, the date correcting mechanism includes a date correcting wheel and the date correcting wheel is arranged not to overlap any one of the second indicating mechanism, the second chronograph train wheel, the minute chronograph train wheel, the hour chronograph train wheel and the date feeding mechanism.

Further, it is preferable that in the chronograph timepiece of the invention, the second indicating mechanism includes a second indicator, a rotational center of the second indicator is arranged on a 3 o'clock direction reference line of the movement at a middle position thereof, the second chronograph train wheel includes a second chronograph wheel, a rotational center of the second chronograph wheel is arranged at a center of the movement, the minute chronograph train wheel includes a minute chronograph wheel, a rotational center of the minute chronograph wheel is arranged on a 9 o'clock direction reference line of the movement at a middle position thereof, the hour chronograph train wheel includes an hour chronograph wheel, a rotational center of the hour chronograph wheel is arranged on a 6 o'clock direction reference line of the movement at a middle position thereof, the date feeding mechanism includes a date indicator driving wheel, a rotational center of the date indicator driving wheel is arranged in a "9 o'clock 12 o'clock region", the calendar mechanism includes a date jumper for restricting a position of the date indicator and the date jumper is arranged to overlap a 12 o'clock direction reference line of the movement. By the constitution, there can be realized a chronograph timepiece having simple structures of the chronograph mechanism and the calendar mechanism.

Further, it is preferable that a chronograph timepiece of the invention further includes a start/stop button arranged

to operate a part disposed at the "12 o'clock 3 o'clock region" of the movement for controlling a coupling operation of the second chronograph train wheel, the minute chronograph train wheel and the hour chronograph train wheel, and a reset button arranged to operate a part disposed in a "3 o'clock 6 o'clock region" of the movement for controlling a zeroing operation of the second chronograph train wheel, the minute chronograph train wheel and the hour chronograph train wheel, a coupling operation lever operated by operating the start/stop button for controlling to operate to rotate and stop the second chronograph train wheel, the minute chronograph train wheel and the hour chronograph train wheel, a hammer operation lever operated by operating the reset button for controlling to operate to zero the second chronograph train wheel, the minute chronograph train wheel and the hour chronograph train wheel and an operating cam for controlling to operate the coupling operation lever. Further, it is preferable that a rotational center of the operating cam is arranged in the "3 o'clock 6 o'clock region" of the movement. By the constitution, there can be realized a chronograph timepiece in which fabrication and assembly of the chronograph mechanism are facilitated.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

A preferred form of the present invention is illustrated in the accompanying drawings in which:



Fig. 1 is a plane view showing a state of viewing a chronograph mechanism and a calendar mechanism from a dial side according to an embodiment of a chronograph timepiece of the invention;

Fig. 2 is a partial plane view showing a state of viewing the chronograph mechanism on the dial side in a start state according to the embodiment of the chronograph timepiece of the invention;

Fig. 3 is a partial plane view showing a state of viewing the chronograph mechanism from the dial side in a stop state according to the embodiment of the chronograph timepiece of the invention;

Fig. 4 is a partial plane view showing a state of viewing the chronograph mechanism from the dial side in resetting according to the embodiment of the chronograph timepiece of the invention;

Fig. 5 is a plane view showing a state of viewing base unit from a side opposed to a dial according to the embodiment of the chronograph timepiece of the invention;

Fig. 6 is a plane view showing a state of viewing the base unit from the dial side according to the embodiment of the chronograph timepiece of the invention;

Fig. 7 is a plane view showing a state of viewing a chronograph unit from the side opposed to the dial according to the embodiment of the chronograph timepiece of the invention;

Fig. 8 is a plane view showing a state of viewing the chronograph unit from the dial side according to the embodiment of the chronograph timepiece of the invention;

Fig. 9 is an outline block diagram showing a transmission path of the train wheel according to the embodiment of the chronograph timepiece of the invention;

Fig. 10 is a partial sectional view showing a transmission path of a date feeding train wheel according to the embodiment of the chronograph timepiece of the invention;

Fig. 11 is a partial sectional view showing a transmission path of an hour chronograph train wheel according to the embodiment of the chronograph timepiece of the invention;

Fig. 12 is a partial sectional view showing a transmission path of a minute chronograph train wheel according to the embodiment of the chronograph timepiece of the invention;

Fig. 13 is a partial sectional view showing a transmission path of a second chronograph train wheel according to the embodiment of the chronograph timepiece of the invention;

Fig. 14 is a partial sectional view showing a transmission path of a calendar correcting train wheel according to the embodiment of the chronograph timepiece of the invention;

Fig. 15 is an outline plane view showing an outlook of a complete of a chronograph timepiece in a state of stopping a chronograph mechanism according to the embodiment of the chronograph timepiece of the invention;

Fig. 16 is a partial plane view of an operating lever and an operating cam in a state of not driving the chronograph mechanism according to the embodiment of the chronograph timepiece of the invention;

Fig. 17 is a partial plane view showing a coupling lever and the operating cam in a state of making the clutch OFF according to the embodiment of the chronograph timepiece of the invention;

Fig. 18 is a partial sectional view showing the coupling lever and the operating cam in a state of making the clutch OFF according to the embodiment of the chronograph timepiece of the invention;

Fig. 19 is a partial plane view showing an hour/minute coupling lever and the operating cam in a state of making the clutch OFF according to the embodiment of the chronograph timepiece of the invention;

Fig. 20 is a partial sectional view showing the hour/minute coupling lever and the operating cam in a state of making the clutch OFF according to the embodiment of the chronograph timepiece of the invention;

Fig. 21 is a partial plane view showing the operating lever and the operating cam in a state of driving the chronograph mechanism according to the embodiment of the chronograph timepiece of the invention;

Fig. 22 is a partial plane view showing the coupling lever and the operating cam in a state of making the clutch ON according

to the embodiment of the chronograph timepiece of the invention;

Fig. 23 is a partial sectional view showing the coupling lever and the operating cam in a state of making the clutch ON according to the embodiment of the chronograph timepiece of the invention;

Fig. 24 is a partial plane view showing the hour/minute coupling lever and the operating cam in a state of making the clutch ON according to the embodiment of the chronograph timepiece of the invention;

Fig. 25 is a partial sectional view showing the hour/minute coupling lever and the operating cam in the state of making the clutch ON according to the embodiment of the chronograph timepiece of the invention;

Fig. 26 is a functional block diagram showing a constitution of a coupling mechanism according to the embodiment of the chronograph timepiece of the invention;

Fig. 27 is a partial plane view showing a stop lever and the operating cam in a run state in a state of making restriction OFF according to the embodiment of the chronograph timepiece of the invention;

Fig. 28 is a partial sectional view showing the stop lever and the operating cam in the run state in the state of making restriction OFF according to the embodiment of the chronograph timepiece of the invention;

Fig. 29 is a partial plane view showing the stop lever

and the operating cam in a stop state in a state of making restriction ON according to the embodiment of the chronograph timepiece of the invention;

Fig. 30 is a partial sectional view showing the stop lever and the operating cam in the stop state in the state of making restriction ON according to the embodiment of the chronograph timepiece of the invention;

Fig. 31 is a partial plane view showing the stop lever and the operating cam in a reset state according to the embodiment of the chronograph timepiece of the invention;

Fig. 32 is a partial sectional view showing the stop lever and the operating cam in the reset state according to the embodiment of the chronograph timepiece of the invention;

Fig. 33 is a partial plane view showing a hammer and the operating cam in the stop state according to the embodiment of the chronograph timepiece of the invention;

Fig. 34 is a partial plane view showing the hammer and the operating cam in the reset state according to the embodiment of the chronograph timepiece of the invention;

Fig. 35 is a functional block diagram showing a constitution of a reset mechanism according to the embodiment of the chronograph timepiece of the invention;

Fig. 36 is a plane view showing a state of viewing a chronograph mechanism and a calendar mechanism from a dial side in a chronograph timepiece piece of a prior art;

Fig. 37 is an outline block diagram showing a transmission path of a train wheel in a chronograph timepiece of the prior art;

Fig. 38 is a partial sectional view showing a transmission path of a second chronograph train wheel in the chronograph timepiece of the prior art;

Fig. 39 is a partial sectional view showing a transmission path of an hour chronograph train wheel in the chronograph timepiece of the prior art;

Fig. 40 is a partial sectional view showing a transmission path of a minute chronograph train wheel in the chronograph timepiece of the prior art; and

Fig. 41 is a partial sectional view showing a transmission path of a calendar feeding train wheel in the chronograph timepiece of the prior art.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the invention will be explained in reference to the drawings as follows.

Further, to make clear the explanation, in the respective drawings, a description of a structure of a portion which is less related to the constitution of the invention is omitted. Therefore, a detailed explanation with regard to a structure of a switching apparatus, a hand setting apparatus, an automatic winding apparatus, a hand winding apparatus, a calendar apparatus,

a calendar correcting apparatus or the like which can utilize a structure similar to that of a chronograph timepiece of a prior art is omitted.

(1) A total constitution of a movement and definition of terminology

In reference to Fig. 1 through Fig. 8, a movement (machine body including drive portion) 100 of a chronograph timepiece of the invention comprises a base unit 101 including a surface train wheel, a back train wheel, a switching apparatus, a hand setting apparatus, an automatic winding apparatus, a hand winding apparatus or the like, and a chronograph unit 300 including a chronograph mechanism, a calendar mechanism (calendar feeding mechanism, calendar correcting mechanism), an indicator driving train wheel or the like. The base unit 101 is constituted to include at least one of the automatic winding apparatus and the hand winding apparatus.

In both sides of a main plate 102, a side having a dial 104 is referred to as "back side" of the movement 100 and a side thereof opposed to the side having the dial 104 is referred to as "surface side" of the movement 100. A train wheel assembled to "surface side" of movement 100 is referred to as "surface train wheel" and a train wheel assembled to "back side" of the movement 100 is referred to as "back train wheel". An outer peripheral portion of a surface of the dial 104 is normally provided with numerals from 1 to 12, or abbreviated characters

in correspondence therewith. Therefore, respective directions along an outer peripheral portion of the timepiece can be represented by using the numerals.

The movement 100 includes the base unit 101 (refer to Fig. 5, Fig. 6) including the surface train wheel, the back train wheel, the switching apparatus, the hand setting apparatus, the automatic apparatus and/or the hand winding apparatus and the like and the chronograph unit 300 (refer to Fig. 1 through Fig. 4) including the chronograph mechanism, the calendar mechanism and the like. The base unit 101 includes the main plate 102 and one piece or more of bridges. The chronograph unit 300 includes a chronograph main plate 302 and the chronograph bridge 312.

For example, in the case of a wrist watch, an upper direction and an upper side of the wrist watch are respectively referred to as "12 o'clock direction" and "12 o'clock side", a right direction and a right side of the wrist watch are respectively referred to as "3 o'clock direction", "3 o'clock side", a lower direction and a lower side of the wrist watch are respectively referred to as "6 o'clock direction" and "6 o'clock side" and a left direction and a left side of the wrist watch are respectively referred to as "9 o'clock direction" and "9 o'clock side". Similarly, an upper direction and an upper side of the movement 100 is respectively referred to as "12 o'clock direction" and "12 o'clock side", a right direction and a right side of the



movement 100 are respectively referred to as "3 o'clock direction" and "3 o'clock side", a lower direction and a lower side of the movement 100 are respectively referred to as "6 o'clock direction" and "6 o'clock side" and a left direction and a left side of the movement 100 are respectively referred to as "9 o'clock direction" "9 o'clock side".

In the movement 100, a position thereof in correspondence with 12 o'clock graduation of the dial 104 is referred to as "12 o'clock position", a position thereof in correspondence with 1 o'clock graduation of the dial 104 is referred to as "1 o'clock position", a position thereof in correspondence with 3 o'clock graduation of the dial 104 is referred to as "3 o'clock position", "4 o'clock position" to "10 o'clock position" are similarly defined, finally, a position thereof in correspondence with 11 o'clock graduation of the dial 104 is referred to as "11 o'clock position".

In the movement 100, a direction directed from a center 402 of the movement 100 to "12 o'clock position" is referred to as "12 o'clock direction", a direction directed from the center 402 of the movement 100 to "1 o'clock position" is referred to as "1 o'clock direction", a direction directed from the center 402 of the movement 100 to "2 o'clock position" is referred to as "2 o'clock direction", a direction directed from the center 402 of the movement 100 to "3 o'clock position" is referred to as "3 o'clock direction", "4 o'clock direction" to "10 o'clock

direction" are similarly defined, finally, a direction directed from the center 402 of the movement 100 to "11 o'clock position" is referred to as "11 o'clock direction".

For example, in Fig. 6, "12 o'clock direction", "3 o'clock direction", "6 o'clock direction" and "9 o'clock direction" of the movement 100 are shown.

In reference to Fig. 5 through Fig. 8, in the movement 100 (base unit 101, chronograph unit 300), at the center 402 of the movement 100, a rotational center of an hour hand 368, a rotational center of a minute hand 364 and a rotational center of a chronograph second hand 324 are disposed (refer to Fig. 15). In the movement 100 (base unit 101, chronograph unit 300), a fan shape region having an opening angle of 90 degrees disposed between a 12 o'clock direction reference line KJ1 directed from the center of the movement 100 (base unit 101, chronograph unit 300) in "12 o'clock direction" and a 3 o'clock direction reference line KJ2 directed from the center of the movement 100 (base unit 101, chronograph unit 300) to "3 o'clock direction" is referred to as "12 o'clock, 3 o'clock region", a fan shape region having an opening angle of 90 degrees disposed between the 3 o'clock direction reference line KJ2 and a 6 o'clock direction reference line KJ3 directed from the center of the movement 100 (base unit 101, chronograph unit 300) to "6 o'clock direction" is referred to as "3 o'clock 6 o'clock region", a fan shape region having an opening angle of 90 degrees disposed between the 6 o'clock

direction reference line KJ3 and a 9 o'clock direction reference line KJ4 directed from the center of the movement 100 (base unit 101, chronograph unit 300) to "9 o'clock direction" is referred to as "6 o'clock 9 o'clock region" and a fan shape region having an opening angle of 90 degrees disposed between the 9 o'clock direction reference line KJ4 and the 12 o'clock direction reference line KJ1 is referred to as "9 o'clock 12 o'clock region". Therefore, in the movement 100 (base unit 101, chronograph unit 300), four pieces of regions of "12 o'clock 3 o'clock region", "3 o'clock 6 o'clock region", "6 o'clock 9 o'clock region" and "9 o'clock 12 o'clock region" are defined. A center axis line of a winding stem 108 is arranged on the 3 o'clock direction reference line KJ2 of the movement 100 (base unit 101).

(2) A constitution of a base unit

In reference to Fig. 5 and Fig. 6, the base unit 101 includes the main plate 102 constituting a base plate of the movement 100, the surface train wheel, the back train wheel, a barrel bridge 112, a train wheel bridge 114, a balance bridge 116, an automatic wiring train wheel bridge 118, an escapement/speed control apparatus, the automatic winding apparatus, the hand winding apparatus, the switching apparatus, a minute wheel bridge 278 and the like.

The winding stem 108 is rotatably integrated to a winding stem guide hole of the main plate 102. The dial 104 (shown in Fig. 10 through Fig. 14 by imaginary lines) is attached to the

movement 100. The escapement/speed control apparatus including a balance with hairspring 140, an escape wheel & pinion (not illustrated), a pallet fork (not illustrated) and the surface train wheel including a second wheel & pinion 138 (refer to Fig. 10), a third wheel & pinion 136 (refer to Fig. 10), a center wheel & pinion (not illustrated) and a barrel complete 130 are arranged on "surface side" of the base unit 101. Further, the barrel complete bridge 112 rotatably supporting an upper shaft of the barrel complete 130 and an upper shaft portion the center wheel & pinion, the train wheel bridge 114 rotatably supporting an upper shaft portion of the third wheel & pinion 136, an upper shaft portion of the second wheel & pinion 138 and an upper shaft portion of the escape wheel & pinion, a pallet fork bridge (not illustrated) rotatably supporting an upper shaft portion of the pallet fork and the balance bridge 116 rotatably supporting the upper shaft of the balance with hairspring 140 are arranged on "surface side" of the base unit 101.

A position of the winding stem 108 in the axis line direction is determined by the switching apparatus including a setting lever, a yoke, a yoke spring, a yoke holder and the like. When the winding stem 108 is rotated in the state of being disposed at a first winding stem position (0 stage) most proximate to an inner side of the movement 100 along the rotational axis line direction, a winding pinion 260 is rotated via rotation of a clutch wheel 276. A crown wheel (not illustrated) is constituted

to rotate by rotation of the winding pinion. A crown transmission wheel (not illustrated) is constituted to rotate by rotation of the crown wheel. A pivoting crown wheel 262 is constituted to rotate by rotation of the crown transmission wheel. A ratchet wheel 256 is rotated by rotation of the pivoting crown wheel 262. The barrel complete 130 includes a barrel wheel 130a, a barrel stem (not illustrated) and a mainspring (not illustrated). By rotating the ratchet wheel 256, the mainspring contained in the barrel complete 130 is constituted to wind up.

The center wheel & pinion is constituted to rotate by rotation of the barrel complete 130. The center wheel & pinion includes a center wheel (not illustrated) and a center pinion (not illustrated). A barrel complete wheel 130a is constituted to be brought in mesh with the center pinion. The third wheel & pinion 136 is constituted to rotate by rotation of the center wheel & pinion. The third wheel & pinion 136 includes a third wheel (not illustrated) and a third pinion (not illustrated). The second wheel & pinion 138 is constituted to rotate by rotation of the third wheel & pinion 136. The second wheel & pinion 138 includes a second wheel (not illustrated) and a second pinion (not illustrated). The third wheel is constituted to be brought in mesh with the second pinion. By rotation of the second wheel & pinion 138, the escape wheel & pinion is constituted to rotate while being controlled by the pallet fork. The escape wheel & pinion includes an escape wheel (not illustrated) and an escape

pinion (not illustrated). The second wheel & pinion is constituted to be brought in mesh with the escape pinion. The barrel complete 130, the center wheel & pinion, the third wheel & pinion 136 and the second wheel & pinion 138 constitute the surface train wheel.

The escapement/speed control apparatus for controlling rotation of the surface train wheel includes a balance with hairspring 140, the escape wheel & pinion and the pallet fork. The balance with hairspring 140 includes a balance stem, a balance ring and a hairspring. The hairspring is a thin plate spring in a mode of a helical shape (spiral shape) having plural turn numbers. The balance with hairspring 140 is rotatably supported by the main plate 102 and the balance bridge 116.

In reference to Fig. 6 and Fig. 10, a minute driving wheel & pinion 124 includes a minute driving wheel 124a and a cannon pinion 124b. The minute driving wheel 124a is constituted to be brought in mesh with the third pinion of the third wheel & pinion 136. The minute driving wheel 124a is constituted to rotate integrally with the cannon pinion 124b. The cannon pinion 124b and the minute driving wheel 124a are provided with a slip mechanism constituted such that the cannon pinion 124b can be slipped relative to the minute driving wheel 124a. A minute holder 278 supports the minute driving wheel & pinion 124 rotatably to the main plate 102.

In reference to Fig. 6 and Fig. 13, a minute wheel & pinion

268 includes a minute wheel 268a and a minute pinion 268b. The cannon pinion 124b is constituted to be brought in mesh with the minute pinion 268b. When the winding stem 108 is pulled out to a state of being disposed at a third winding stem position (2 stage) along the rotational axis line direction, a setting lever 280 is rotated. When the winding stem 108 is rotated under the state, the setting wheel 266 is rotated via rotation of the clutch wheel 276. By rotation of the setting wheel 266, the cannon pinion 124b is constituted to rotate via rotation of the minute wheel 268. Therefore, by pulling out the winding stem 108 to the second stage and rotating the winding stem 108, the hands are constituted to be able to set.

In reference to Fig. 5 and Fig. 6, the automatic winding apparatus includes an oscillating weight 250, an intermediate first wheel & pinion 252 rotated based on rotation of the oscillating weight 250, an intermediate first wheel & pinion 252 rotated based on rotation of the oscillating weight 250, an intermediate second wheel & pinion (not illustrated) rotated based on rotation of the intermediate first wheel & pinion 252, a switching reduction wheel & pinion (not illustrated) rotated in one direction based on rotation of the intermediate first wheel & pinion 252 and the intermediate second wheel & pinion, a first reduction wheel (not illustrated) rotated based on rotation of the switching reduction wheel & pinion, a second reduction wheel (not illustrated) rotated based on rotation of

the first reduction wheel and a third reduction wheel & pinion 254 rotated based on rotation of the second reduction wheel. A third reduction pinion of the third reduction wheel & pinion 254 is constituted to be brought in mesh with the ratchet wheel 256.

The hand winding apparatus includes the winding wheel 260 rotated by rotation of the winding stem 108, the crown wheel (not illustrated) rotated by rotation of the winding wheel 260, a crown reduction wheel (not illustrated) rotated by rotation of the crown wheel, the pivoting crown wheel 262 rotated by rotation of the crown reduction wheel, the ratchet wheel 256 in one direction based on rotation of the pivoting crown wheel 262 and a click 258 for preventing reverse rotation of the ratchet wheel 256. The position of the winding stem 108 in the axis line direction is determined by the switching apparatus including the setting lever 270, the yoke 272, the yoke holder 274 and the like. When the winding stem 108 is rotated in a state in which the winding stem 108 is disposed at a first winding stem position (0 stage) most proximate to the inner side of the movement 100 along the rotational axis line direction, the winding wheel 260 is rotated via rotation of the clutch wheel 276. By rotation of the winding wheel 260, the crown reduction wheel is rotated via rotation of the crown wheel. By rotation of the crown reduction wheel, the pivoting crown wheel 262 is rotated. The ratchet wheel 256 can wind up the mainspring by being rotated



in one direction based on rotation of the pivoting crown wheel 262.

In reference to Fig. 6 and Fig. 14, the back train wheel includes the setting wheel 266 and the minute wheel 268. The calendar correcting apparatus includes a setting lever 280, the date corrector setting transmission wheel A282, a date corrector setting transmission wheel B284, a date corrector setting transmission wheel C286, a date corrector setting wheel 288 and the like. The rotational center of the minute wheel 268 is arranged in the "3 o'clock 6 o'clock region".

(3) A constitution of an hour/minute indicating mechanism

In reference to Fig. 8 through 10, a second minute wheel & pinion 360 is arranged rotatably relative to a chronograph main plate 302. The second minute wheel & pinion 360 includes a second minute wheel A360a, a second minute wheel B360b, a second minute pinion A360c and a second minute pinion B360d. The second minute wheel A360a is brought in mesh with the cannon pin 124b. A rotational center of the second minute wheel 360 is arranged in the "9 o'clock 12 o'clock region". The second minute wheel & pinion 360 is rotated by rotation of the minute driving wheel 124. The second minute driving wheel 362 is rotated by rotation of the second minute wheel B360b. The second minute driving wheel 362 is arranged to be rotatable relative to a second minute wheel pipe fixed to the chronograph bridge 312. "Minute" of current time is indicated by the minute hand 364 attached to

the second minute driving wheel 362. The hour wheel 366 is rotated by rotation of the second minute pinion B360d. "Hour" of current time is indicated by the hour hand 368 attached to the hour wheel 366.

When the winding stem 108 is pulled out to the second stage and the winding stem 108 is rotated, the setting wheel 266 is rotated via rotation of the clutch wheel 276. The cannon pinion 124b is rotated by rotation of the setting wheel 266 via rotation of the minute wheel 268. The second minute wheel 360 is rotated by rotation of the cannon pinion 124b. The second minute driving wheel 362 and the hour wheel 366 are rotated by rotation of the second minute wheel 360. Therefore, the hands can be set by pulling out the winding stem 108 to the second stage and rotating the winding stem 108.

#### (4) A constitution of a calendar mechanism

In reference to Fig. 8 through Fig. 10, an intermediate date indicator driving wheel & pinion 370 is rotated by rotation of the second minute wheel 360. The intermediate date indicator driving wheel & pinion 370 includes an intermediate date indicator driving wheel 370a and an intermediate date indicator driving pinion 370b. The intermediate data indicator driving wheel 370a is brought in mesh with the second minute pinion A360c. A date indicator driving wheel 372 is rotated by rotation of the intermediate date indicator driving wheel & pinion 370. A date feeding finger 374 is rotated integrally with the date

indicator driving wheel & pinion 372. A rotational center of the date indicator driving wheel 372 and the rotational center of the intermediate date indicator driving wheel & pinion 370 are arranged at the "9 o'clock 12 o'clock region". That is, the date feeding mechanism is arranged at the "9 o'clock 12 o'clock region". The date indicator driving wheel 372 is arranged not to overlap the train wheel constituting the chronograph mechanism. The intermediate date indicator driving wheel & pinion 370 is arranged not to overlap the train wheel constituting the chronograph mechanism.

A date indicator 376 having 31 pieces of inner teeth is arranged rotatably to the chronograph bridge 312. A date feeding finger 374 can rotate the date indicator 376 by one tooth per day. A date jumper 378 is provided for restricting a position of the date indicator 376 in the rotational direction. A rotational center of the date jumper 378 is arranged at the "12 o'clock 3 o'clock region". The date jumper 378 is arranged not to overlap the train wheel constituting the chronograph mechanism. It is preferable to arrange the date jumper 378 to overlap the 12 o'clock direction reference line KJ1 of the movement 100 (chronograph unit 300).

A position of the date jumper 378 for restricting the date indicator 376 is arranged in "12 o'clock direction". That is, it is preferable to constitute such that the 12 o'clock direction reference line KJ1 of the movement 100 (chronograph unit 300)

is disposed between two teeth of the date indicator 376 restricted by the date jumper 378. By the constitution, there can be realized a thin type chronograph timepiece having a thin type chronograph mechanism capable of firmly restricting two teeth of the date indicator 376.

A date indicator holder 380 is arranged to the chronograph bridge 312 in order to rotatably support the teeth portion of the date indicator 376. Current (date) can be displayed in a date window (not illustrated) of the dial 104 by numerals of "1" through "31" (not illustrated) provided at the date indicator 376.

(5) A constitution of an hour chronograph train wheel

In reference to Fig. 1 through Fig. 4, Fig. 8, Fig. 9 and Fig. 11, an intermediate hour chronograph wheel & pinion 330 is arranged rotatably to the chronograph bridge 312. It is preferable that a rotational center of the intermediate hour chronograph wheel & pinion 330 is arranged on the 6 o'clock direction reference line KJ3 of the movement 100. The rotational center of the intermediate hour chronograph wheel & pinion 330 may be arranged to dispose at the "3 o'clock 6 o'clock region" of the movement 100 or arranged to dispose at the "6 o'clock 9 o'clock region" of the movement 100. It is particularly preferable to arrange the intermediate hour chronograph wheel & pinion 330 to overlap the 6 o'clock direction reference line KJ3 of the movement 100. A small-sized thin type chronograph

timepiece can be realized by the constitution.

The intermediate hour chronograph wheel & pinion 330 is arranged to rotate by rotation of the hour wheel 366. The intermediate hour chronograph wheel & pinion 330 includes an intermediate hour chronograph wheel 330b and an intermediate hour chronograph pinion 330c. The intermediate hour chronograph wheel 330b is brought in mesh with the hour wheel 366. An hour chronograph wheel & pinion 332 is arranged to be rotatable to the chronograph main plate 302 and the chronograph bridge 312. The hour chronograph wheel & pinion 332 is arranged to rotate by rotation of the intermediate hour chronograph wheel & pinion 330.

The hour chronograph wheel & pinion 332 includes an hour chronograph wheel 332b, an hour chronograph wheel shaft 332c, an hour heart cam 332d, an hour chronograph wheel clutch spring 332e, an hour chronograph wheel clutch holding seat 332f, an hour chronograph wheel clutch spring receiving seat 332g, an hour chronograph wheel clutch ring 332h, an hour chronograph wheel clutch holding seat pin 332j and an hour chronograph wheel receiving seat 332k. The hour chronograph wheel clutch spring holding seat 332f and the hour chronograph wheel receiving seat 332k are fixed to the hour chronograph wheel shaft 332c. The hour chronograph wheel clutch spring holding seat pin 332j is fixed to the hour chronograph wheel clutch spring holding seat 332f.

The hour heart cam 332d and the hour chronograph wheel spring receiving seat 332g are fixed to the hour chronograph wheel clutch ring 332h. The hour heart cam 332d, the hour chronograph wheel spring receiving seat 332g and the hour chronograph wheel clutch ring 332h are integrated to the hour chronograph wheel shaft 332c to be movable in an axis line direction of the hour chronograph wheel shaft 332c. By the hour chronograph wheel clutch spring holding seat pin 332j, the hour heart cam 332d, the hour chronograph wheel spring receiving seat 332g and the hour chronograph wheel clutch ring 332h are constituted not to rotate relative to the hour chronograph wheel clutch spring holding seat 332f and the hour chronograph wheel shaft 332c. By the hour chronograph wheel clutch spring 332e, the hour chronograph wheel clutch ring 332h is constituted to be pressed to the hour chronograph wheel 332b. The hour chronograph wheel 332b is constituted to be rotatable relative to the hour chronograph wheel receiving seat 332k and the hour chronograph wheel shaft 332c.

The hour chronograph wheel 332b is brought in mesh with the intermediate hour chronograph wheel 330b. A rotational center of the hour chronograph wheel & pinion 332 is arranged at a middle position on the 6 o'clock direction reference line KJ3 of the movement 100 (chronograph unit 300). For example, it is preferable that the rotational center of the hour chronograph wheel & pinion 332 is arranged on the 6 o'clock

direction reference line KJ3 at a position in a range of 40 through 70 % of a radius of the main plate 102.

When an hour/minute coupling lever 442 is operated by operating a start/stop button 306, by the spring force of the hour chronograph wheel clutch spring 332e, a lower face of the hour chronograph wheel clutch ring 332h is brought into contact with the upper face of the hour chronograph wheel 332b. Therefore, under the state, the hour chronograph wheel shaft 332c is rotated in cooperation with the hour chronograph wheel 332b. Therefore, under the state, the hour chronograph wheel shaft 332c is rotated by rotation of the intermediate hour chronograph wheel & pinion 330. That is, the hour chronograph wheel clutch ring 332h and the hour chronograph wheel clutch spring 332e constitute a "clutch". In chronograph measuring operation, by a chronograph hour hand 338 attached to the hour chronograph wheel shaft 332c, a result of measuring an elapse time period of "hour" such as elapse of one hour is indicated. After stopping to measure chronograph, when a hammer 464 is operated by operating a reset button 308, the hammer 464 rotates the hour heart cam 332d and the chronograph hour hand 338 can be zeroed.

(6) A constitution of a minute chronograph train wheel

In reference to Fig. 1 through Fig. 4, Fig. 8, Fig. 9 and Fig. 12, an intermediate minute chronograph wheel & pinion A340 is arranged to be rotatable to the chronograph main plate 302 and the chronograph bridge 312. The intermediate minute

chronograph wheel & pinion A340 is arranged to rotate by rotation of the second minute wheel & pinion 360. A pinion portion of the intermediate minute chronograph wheel & pinion A340 is brought in mesh with the second minute wheel B360b. An intermediate minute chronograph wheel & pinion B341 is arranged to be rotatable to the chronograph main plate 302 and the chronograph bridge 312. The intermediate minute chronograph wheel & pinion B341 is arranged to rotate by rotation of the intermediate minute chronograph wheel & pinion A340. A pinion portion of the intermediate minute chronograph wheel & pinion B341 is brought in mesh with a wheel portion of the intermediate minute chronograph wheel & pinion A340. A minute chronograph wheel & pinion 342 is arranged to be rotatable to the chronograph main plate 302 and the chronograph bridge 312. The minute chronograph wheel & pinion 342 is arranged to rotate by rotation of the intermediate minute chronograph wheel & pinion B341.

The minute chronograph wheel & pinion 342 includes a minute chronograph wheel 342b, a minute chronograph wheel shaft 342c, a minute heart cam 342d, a minute chronograph wheel clutch spring 342e, a minute chronograph wheel clutch spring holding seat 342f, a minute chronograph wheel clutch spring receiving seat 342g, a minute chronograph clutch ring 342h, a minute chronograph wheel clutch spring holding seat pin 342j and a minute chronograph wheel receiving seat 342k. The minute chronograph wheel clutch spring holding seat 342f and the minute chronograph wheel



receiving seat 342k are fixed to the minute chronograph wheel shaft 342c. The minute chronograph clutch spring holding seat pin 342j is fixed to the minute chronograph wheel clutch spring holding seat 342f.

The heart cam 342d and the minute chronograph wheel spring receiving seat 342g are fixed to the minute chronograph wheel clutch ring 342h. The minute heart cam 342d, the minute chronograph wheel spring receiving seat 342g and the minute chronograph wheel clutch ring 342h are integrated to the minute chronograph wheel shaft 342c to be movable in an axis line direction of the minute chronograph wheel shaft 342c. By the minute chronograph wheel clutch spring holding seat pin 342j, the minute heart cam 342d, the minute chronograph wheel spring receiving seat 342g and the minute chronograph clutch ring 342h are constituted not to rotate relative to the minute chronograph wheel clutch spring holding seat 342f and the minute chronograph wheel shaft 342c. By the minute chronograph wheel clutch spring 342e, the minute chronograph wheel clutch ring 342h is constituted to be pressed to the minute chronograph wheel 342b. The minute chronograph wheel 342b is constituted to be rotatable relative to the minute chronograph wheel receiving seat 342k and the minute chronograph wheel shaft 342c. The minute chronograph wheel 342b is brought in mesh with a wheel portion of the intermediate minute chronograph wheel & pinion B341.

A rotational center of the minute chronograph wheel &

pinion 342 is arranged at a middle position on the 9 o'clock direction reference line KJ4 of the movement 100 (chronograph unit 300). For example, it is preferable that the rotational center of the minute chronograph wheel & pinion 342 is arranged on the 9 o'clock direction reference line KJ4 at a position in a range of 40 through 70% of the radius of the main plate 102. It is preferable that a distance from the center of the movement 100 (chronograph unit 300) to the rotational center of the minute chronograph wheel & pinion 342 is constituted to be equal to a distance from the center of the movement 100 (chronograph unit 300) to the rotational center of the hour chronograph wheel & pinion 332. By the constitution, there can be realized a chronograph timepiece capable of displaying hour chronograph and displaying minute chronograph which are easy to see.

When an hour/minute coupling lever 442 is operated by operating the start/stop button 306, by spring force of the minute chronograph wheel clutch spring 342e, a lower face of the minute chronograph wheel clutch ring 342h is brought in contact with an upper face of the minute chronograph wheel 342b. Therefore, under the state, the minute chronograph wheel shaft 342c is rotated in cooperation with the minute chronograph wheel 342b. Under the state, by rotation of the second minute wheel & pinion 360, the minute chronograph wheel shaft 332c is rotated via rotation of the intermediate minute chronograph wheel & pinion A340 and the intermediate minute chronograph wheel & pinion B341.

That is, the minute chronograph clutch ring 342h and the minute chronograph wheel clutch spring 340e constitute a "clutch". In the chronograph measuring operation, by the chronograph minute hand 348 attached to the minute chronograph wheel shaft 342c, a result of measuring an elapse time period of "minute" such as elapse of one minute is displayed. After stopping to measure chronograph, when the hammer 464 is operated by operating the reset button 308, the hammer 464 rotates the minute heart cam 342d and the chronograph minute hand 348 can be zeroed.

A rotational center of the second minute wheel & pinion 360, a rotational center of the intermediate minute chronograph wheel & pinion A340 and a rotational center of the intermediate minute chronograph wheel & pinion B341 are arranged at the "9 o'clock 12 o'clock region". The intermediate minute chronograph wheel & pinion A340 and the intermediate minute chronograph wheel & pinion B341 are arranged not to overlap a train wheel constituting a date feeding mechanism. The intermediate minute chronograph wheel & pinion A340 and the intermediate minute chronograph wheel & pinion B341 are arranged not to overlap a part constituting a date correcting mechanism. By the constitution, a small-sized thin type chronograph timepiece can be realized.

(7) Constitutions of a second indicating mechanism and a second chronograph train wheel

In reference to Fig. 1 through Fig. 4, Fig. 8, Fig. 9 and

Fig. 13, an intermediate second chronograph wheel & pinion 320 is arranged to be rotatable to the chronograph main plate 302 and the chronograph bridge 312. The intermediate second chronograph wheel & pinion 320 includes an intermediate second chronograph wheel shaft 320b, an intermediate second chronograph wheel 320c, an intermediate second chronograph clutch ring 320d, an intermediate second chronograph clutch spring 320e, an intermediate second wheel 320f and an intermediate second wheel holding seat 320g.

The intermediate second chronograph wheel 320c is fixed to the intermediate second chronograph wheel shaft 320b. The intermediate second wheel holding seat 320g is fixed to the intermediate second chronograph wheel shaft 320b. The intermediate second wheel 320f is rotatably provided to the intermediate second chronograph wheel shaft 320b. The intermediate second chronograph clutch ring 320d and the intermediate second chronograph clutch spring 320e are integrally formed. The intermediate second chronograph clutch ring 320d and the intermediate second chronograph clutch spring 320e are integrated to the intermediate second chronograph wheel shaft 320b to be movable in an axial direction of the intermediate second chronograph wheel shaft 320b. By the intermediate second chronograph clutch spring 320e, the intermediate second chronograph clutch ring 320d is constituted to be pressed to the intermediate second wheel 320f.

The second reduction wheel & pinion 318 is fixed to the second wheel & pinion 138. The second reduction wheel & pinion 318 is arranged between a minute holder 278 and the chronograph main plate 302. The intermediate second wheel 320f is rotated by rotation of the second reduction wheel & pinion 318. The second indicator 352 is rotated by rotation of the intermediate second wheel 320f. By a second hand (small second hand) 354 attached to the second indicator 352, "second" of current time is indicated. That is, the second indicator 352 constitutes a second indicating mechanism. A rotational center of the second indicator 352 is arranged at a middle position on the 3 o'clock direction reference line KJ2 of the movement 100 (chronograph unit 300). For example, it is preferable to arrange the rotational center of the second indicator 352 on the 3 o'clock direction reference line KJ2 at a position disposed in a range of 40 through 70 % of the radius of the main plate 102.

It is preferable to arrange the second indicator 352 not to overlap the date feeding mechanism and arrange not to overlap the date correcting mechanism. By the constitution, a small-sized thin type chronograph timepiece can be realized.

It is preferable to constitute a distance from the center 402 of the movement 100 (chronograph unit 300) to the rotational center of the second indicator 352 to be equal to a distance from the center of the movement 100 (chronograph unit 300) to the rotational center of the minute chronograph wheel & pinion

342 and the distance from the center 402 of the movement 100 (chronograph unit 300) to the rotational center of the hour chronograph wheel & pinion 332. By the constitution, there can be realized a chronograph timepiece capable of displaying second, displaying hour chronograph and displaying minute chronograph which are easy to see.

When a coupling lever A444 and a coupling lever B446 are operated by operating the start/stop button 306, by the spring force of the intermediate second chronograph wheel clutch spring 320e, the intermediate second chronograph wheel clutch ring 320d is pressed to the intermediate second wheel 320f. Under the state, the intermediate second chronograph wheel 320c and the intermediate second chronograph wheel shaft 320b are rotated in cooperation with the intermediate second wheel 320f. That is, under the state, the intermediate second chronograph wheel 320c is rotated by rotation of the second reduction wheel & pinion 318. The intermediate second chronograph wheel clutch ring 320d and the intermediate second chronograph wheel clutch spring 320e constitute a "clutch".

The second chronograph wheel & pinion 322 is rotated by rotation of the intermediate second chronograph wheel 320c. The second chronograph wheel & pinion 322 includes a second chronograph wheel 322b, a second chronograph wheel shaft 322c, a second heart cam 322d and a stop lever plate 322f. The rotational center 402 of the second chronograph wheel & pinion

322 is the same as the rotational center of the second wheel & pinion 138, the same as the rotational center of the minute driving wheel 124, the same as the rotational center of the second minute driving wheel & pinion 362 and the same as the rotational center of the hour wheel 366. The rotational center of the minute driving wheel 124 and the rotational center of the hour wheel 366 are arranged at the center 402 of the movement 100 (chronograph unit 300).

It is preferable to arrange the rotational center of the intermediate second chronograph wheel & pinion 320 to dispose on the 3 o'clock direction reference line KJ2 of the movement 100. The rotational center of the intermediate second chronograph wheel & pinion 320 may be arranged to dispose in the "12 o'clock 3 o'clock region" of the movement 100 or arranged to dispose in the "3 o'clock 6 o'clock region" of the movement 100. It is particularly preferable to arrange the intermediate second chronograph wheel & pinion 320 to overlap the 3 o'clock direction reference line KJ2 of the movement 100. By the constitution, the small-sized thin type chronograph timepiece can be realized.

In the chronograph measuring operation, by the chronograph second hand 324 attached to the second chronograph wheel shaft 322c, a result of measuring an elapse time period of "second" such as elapse of one second is displayed. After stopping to measure chronograph, when the hammer 464 is operated by operating

the reset button 308, the hammer 464 rotates the second heart cam 322d and the chronograph second hand 324 can be zeroed.

(8) A constitution of a calendar correcting mechanism

In reference to Fig. 1, Fig. 6 through Fig. 9 and Fig. 14, when the winding stem 108 is pulled to a state of being disposed at the second winding stem position (1 stage) along the rotational axis line direction, the setting lever 280 is rotated. Under the state, when the winding stem 108 is rotated, the setting wheel 266 is rotated via rotation of the clutch wheel 276. The date corrector setting transmission wheel B284 is constituted to rotate by rotation of the setting wheel 266 via rotation of the date corrector setting transmission wheel A282. The date corrector setting transmission wheel C286 is constituted at one end of the date corrector setting transmission wheel B284 to rotate along with the date corrector setting transmission wheel B284. Therefore, the date corrector setting wheel 288 is constituted to rotate by rotation of the date corrector setting transmission wheel B284 via the rotation of the date corrector setting transmission wheel C286. A rotational center of the date corrector setting wheel 288 and a rotational center of the date corrector setting transmission wheel C286 are arranged at the "12 o'clock 3 o'clock region". The date corrector setting wheel 288 is arranged not to overlap the train wheel constituting the chronograph mechanism. That is, the date correction mechanism is arranged at the "12 o'clock 3 o'clock region". The



date correcting mechanism is arranged not to overlap the date feeding mechanism. By the constitution, a small size and a thin type chronograph timepiece can be realized.

The date corrector setting wheel 288 is constituted to be able to rotate the date indicator 376 when rotated in one direction. According to the constitution, by pulling out the winding stem 108 to the second winding stem position (1 stage) and rotating the winding stem 108 in one direction, the date indicator 376 can be rotated and date correction can be carried out.

#### (9) A chronograph operating mechanism

Next, a constitution of a chronograph operating mechanism will be explained.

##### (9-1) A state of not operating to measure chronograph

In reference to Fig. 1, Fig. 16 and Fig. 26, a constitution of a chronograph operating mechanism in a state of not operating to measure chronograph will be explained. The start/stop button 306 is provided in the 2 o'clock direction of the movement 100. Although it is preferable to arrange a center axis line of the start/stop button 306 in the 2 o'clock direction of the movement 100, the center axis line may be arranged at a position other than the 2 o'clock direction between the 1 o'clock direction and the 3 o'clock direction of the movement 100. The start/stop button 306 is arranged to operate to a part disposed in the "12 o'clock 3 o'clock region" of the movement 100.

By depressing the start/stop button 306 in a direction designated by an arrow mark, an operating lever A412 is constituted to be able to rotate. A position at which the operating lever A412 is brought into contact with the start/stop button 306 is disposed in the "12 o'clock 3 o'clock region" of the movement 100. The operating lever A412 is arranged to be rotatable by constituting a rotational center by an operating lever A rotating shaft 412k. An operating lever spring 414 includes a spring portion 414b. A front end portion 414c of the spring portion 414b of the operating lever spring 414 presses the operating lever A412 to the start/stop button 306 to rotate in the counterclockwise direction. The operating lever spring 414 is attached to the chronograph main plate 302 by an operating lever spring stop screw 414c. An operating lever B416 is fixed with an operating lever B pin 416b. A portion of the operating lever B pin 416b is arranged at a round hole 412h provided at the operating lever A412 and other portion thereof is arranged to be guided by a guide hole 302h in the shape of a long hole provided at the chronograph main plate 302.

After depressing the start/stop button 306, when the finger is separated from the start/stop button 306, by the spring force of the operating lever spring 414, the operating lever 412 is constituted to rotate in the counterclockwise direction. The start/stop button 306 is constituted to return to the original position by spring force of a return spring integrated to an

outer case.

The reset button 308 is provided in the 4 o'clock direction of the movement 100 and by depressing the reset button 308 in a direction designated by an arrow mark, the hammer transmission lever A480 is constituted to be able to rotate. After depressing the reset button 308, when the finger is separated from the reset button 308, by the spring force of the click spring 418, the hammer transmission lever A480 is constituted to rotate in the clockwise direction. By the spring force of a return spring integrated to the outer case, the reset button 308 is constituted to return to an original position. Although it is preferable that a center axis line of the reset button 308 is arranged in the 4 o'clock direction of the movement 100, the center axis line may be arranged at a position other than the 4 o'clock direction between the 3 o'clock direction and the 6 o'clock direction of the movement 100. The reset button 308 is arranged to operate a part disposed in the "3 o'clock 6 o'clock region" of the movement 100. A position at which the hammer transmission lever A480 is brought into contact with the reset button 308 is constituted to dispose in the "3 o'clock 6 o'clock region" of the movement 100.

An operating cam 420 includes drive teeth 422 and the ratchet teeth 424 and is provided rotatably. A rotational center of the operating cam 420 is arranged in the "3 o'clock 6 o'clock region" of the movement 100. A number of teeth of the ratchet

teeth 424 is 16. A number of teeth of the drive teeth 422 is 8 which is  $1/2$  of the number of teeth of the ratchet teeth 424. Therefore, when the ratchet teeth 424 are fed by 1 pitch, the drive teeth 422 are fed by  $1/2$  pitch. The operating cam 420 is attached to the chronograph main plate 302 rotatably by an operating cam stop screw 420c. The front end portion 414c of the spring portion 414b of the operating lever spring 414 presses a front end portion 416c of the operating lever B416 to the ratchet teeth 424 of the operating cam 420 such that the operating lever B416 is rotated in the counterclockwise direction by constituting a rotational center by the operating lever B pin 416b.

When one location in correspondence with an outer periphery of the drive teeth 422 is viewed, at each time of feeding the ratchet teeth 424 by 1 pitch, ridge portions 422t and valley portions 422u of the drive teeth 422 are constituted to dispose at the location alternately. So far as the number of teeth of the ratchet teeth 424 is twice as much as the number of teeth of the drive teeth 422, the number of teeth of the ratchet teeth 424 may not be 16. However, the number of teeth of the ratchet teeth 424 is an even number.

An operating cam jumper 426 having a spring portion is provided. A restricting portion 426a of the operating cam jumper 426 restricts the ratchet teeth 424 to determine a position of the operating cam 420 in the rotational direction. Therefore, by the ratchet teeth 424 and the operating cam jumper 426, the

operating cam 420 is rotated by 360/16 degrees and is firmly positioned at the position. The front end portion 416c of the operating lever B416 is arranged to be brought into contact with the ratchet teeth 424.

In reference to Fig. 1, Fig. 17, Fig. 18 and Fig. 26, the coupling lever A444 is rotatably provided centering on a coupling lever A rotating shaft 444k. The coupling lever A444 includes a coupling lever front end portion 444a, a coupling lever B contact portion 444b and a clutch ring contact portion 444c. The coupling lever front end portion 444a is brought into contact with an outer peripheral portion of the ridge portion 422t of the drive teeth 422.

The coupling lever B446 is rotatably provided centering on a coupling lever B rotating shaft 446k. The coupling lever B446 includes a coupling lever A contact portion 446a, a coupling lever spring contact portion 446b and a clutch ring contact portion 446c. The coupling lever spring 448 includes a spring portion 448b. The spring portion 448b of the coupling lever spring 448 presses the coupling lever spring contact portion 446b of the coupling lever B446 such that the coupling lever B446 is rotated in the clockwise direction by constituting a rotational center by the coupling lever B rotating shaft 446k. The coupling lever B446 presses the coupling lever front end portion 444a of the coupling lever A444 to the outer peripheral portion of the ridge portion 422t of the drive teeth 422 such

that the coupling lever A444 is rotated in the counterclockwise direction by constituting a rotational center by the coupling lever A rotating shaft 444k.

The clutch ring contact portion 444c of the coupling lever A444 and the clutch ring contact portion 446c of the coupling lever B446 are brought into contact with the intermediate second chronograph wheel clutch ring 320d of the intermediate second chronograph wheel & pinion 320 to make clutch OFF. Therefore, under the state, even when the intermediate second wheel 320f is rotated, the intermediate second chronograph wheel 320c is not rotated and the chronograph second hand 324 is not rotated.

In reference to Fig. 1, Fig. 19, Fig. 20 and Fig. 26, the hour/minute coupling lever 442 is rotatably provided centering on an hour/minute coupling lever rotating shaft 442k. The hour/minute coupling lever 442 includes an hour/minute coupling lever front end portion 442a, a click spring contact portion 442b, an hour clutch ring contact portion 442c and a minute clutch ring contact portion 442d. The hour/minute coupling lever front end portion 442a is brought into contact with the outer peripheral portion of the ridge portion 422t of the drive teeth 422.

The click spring 418 includes an hour/minute coupling lever spring portion 418b and a hammer transmission lever spring portion 418c. The hour/minute coupling lever spring portion 418b of the click spring 418 presses the click spring contact portion 442b of the hour/minute coupling lever 442 such that

the hour/minute coupling lever 442 is rotated in the counterclockwise direction by constituting a rotational center by the hour/minute coupling lever rotating shaft 442k. The hour/minute coupling lever 442 presses the hour/minute coupling lever front end portion 442a of the hour/minute coupling lever 442 to the outer peripheral portion of the ridge portion 422t of the drive teeth 422 such that the hour/minute coupling lever 442 is rotated in the clockwise direction by constituting a rotational center by the hour/minute coupling lever rotating shaft 442k.

The hour clutch ring contact portion 442c of the hour/minute coupling lever 442 is brought into contact with the hour chronograph wheel clutch ring 332h of the hour chronograph wheel 332 to make clutch OFF. Therefore, under the state, even when the hour chronograph wheel 332b is rotated, the hour chronograph wheel shaft 332c is not rotated and the chronograph hour hand 338 is not rotated. Further, the minute clutch ring contact portion 442d of the hour/minute coupling lever 442 is brought into contact with the minute chronograph wheel clutch ring 342h of the minute chronograph wheel 342 to make clutch OFF. Therefore, under the state, even when the minute chronograph wheel 342b is rotated, the minute chronograph wheel shaft 342c is not rotated and the chronograph minute hand 348 is not rotated.

(9-2) A state of operating to measure chronograph

In reference to Fig. 2 and Fig. 21, an explanation will be given of a constitution of a chronograph operating mechanism in a state of operating to measure chronograph. When the start/stop button 306 is depressed in the direction designated by the arrow mark, the operating lever A412 is rotated in the clockwise direction by constituting the rotational center by the operating lever A rotating shaft 412k. The operating lever B pin 416b of the operating lever B416 is guided by the guide hole 302h of the chronograph mainplate 302 to move the operating lever B416.

When the start/stop button 306 is pressed and the operating lever B416 is moved, the front end portion 416c of the operating lever B416 rotates the ratchet teeth 424 of the operating cam 420 by 1 pitch in the counterclockwise direction. The restricting portion 426a of the operating cam jumper 426 restricts the ratchet teeth 424 to determine the position of the operating cam 420 in the rotational direction. Therefore, when the start/stop button 306 is depressed to move the operating lever B416, the operating cam 420 is rotated by  $360/16$  degrees.

In reference to Fig. 2, Fig. 22 and Fig. 23, when the operating cam 420 is rotated by  $360/16$  degrees, the coupling lever A444 is rotated centering on the coupling lever A rotating shaft 444k and the coupling lever front end portion 444a is disposed at the valley portion 422u of the drive teeth 422. Further, when the coupling lever A444 is rotated, the coupling



lever B446 is also rotated centering on the coupling lever B rotating shaft 446k.

When the coupling lever A444 is rotated, the clutch ring contact portion 444c of the coupling lever A444 is separated from the intermediate second chronograph wheel clutch ring 320d of the intermediate second chronograph wheel & pinion 320 to make clutch ON. When the coupling lever B446 is rotated, the clutch ring contact portion 446c of the coupling lever B446 is separated from the intermediate second chronograph wheel clutch ring 320d of the intermediate second chronograph wheel & pinion 320 to make clutch ON. Therefore, under the state, when the intermediate second chronograph wheel shaft 320b is rotated, the intermediate second chronograph wheel 320c is rotated and the chronograph second hand 324 is also rotated.

In reference to Fig. 2, Fig. 24 and Fig. 25, when the operating cam 420 is rotated by  $360/16$  degrees, the hour/minute coupling lever 442 is rotated centering on the hour/minute coupling lever rotating shaft 442k and the hour/minute coupling lever front end portion 442a is disposed at the valley portion 422t of the drive teeth 422. When the hour/minute coupling lever 442 is rotated, the hour clutch ring contact portion 442c of the hour/minute coupling lever 442 is separated from the hour chronograph wheel clutch ring 332h of the hour chronograph wheel 332 to make clutch ON. Therefore, under the state, when the hour chronograph wheel 332b is rotated, the hour chronograph

wheel shaft 332c is rotated and the chronograph hour hand 338 is also rotated. Further, when the hour/minute coupling lever 442 is rotated, the minute clutch ring contact portion 442d of the hour/minute coupling lever 442 is separated from the minute chronograph wheel clutch ring 342h of the minute chronograph wheel 342 to make clutch ON. Therefore, under the state, when the minute chronograph wheel 342b is rotated, the minute chronograph wheel shaft 342c is rotated and the chronograph minute hand 348 is also rotated.

(9-3) A constitution and operation of a stop lever

In reference to Fig. 2, Fig. 27 and Fig. 28, a stop lever 440 includes a stop lever spring 450 and a stop lever body 452. The stop lever body 452 is rotatably provided centering on a stop lever rotating shaft 440k. A stop lever spring holding pin 440f is provided at the chronograph main plate 302. The stop lever spring 450 includes a positioning portion 450g and a spring portion 450h. The stop lever body 452 includes an operating cam contact portion 452a, a stop lever spring contact portion 452b and a restricting portion 452c. The front end portion of the spring portion 450h of the stop lever spring 450 presses the stop lever spring contact portion 452b to rotate the stop lever body 452 in the clockwise direction.

In the state of operating to measure chronograph, the operating cam contact portion 452a of the stop lever body 452 is brought into contact with the outer peripheral portion of

the ridge portion 422t of the drive teeth 422. Therefore, under the state, the restricting portion 452c of the stop lever body 452 is separated from the stop lever plate 322f. Therefore, under the state, the second chronograph shaft 322c is not restricted.

In reference to Fig. 3, Fig. 29 and Fig. 30, in a state of stopping to measure chronograph, when the operating cam 420 is rotated by  $360/16$  degrees, the operating cam contact portion 452a of the stop lever body 452 is disposed in the valley portion 422u of the drive teeth 422. Therefore, under the state, by the spring force of the spring portion 450h of the stop lever spring 450, the restricting portion 452c of the stop lever body 452 is brought into contact with the stop lever plate 322f. Therefore, under the state, the second chronograph shaft 322c is restricted and the chronograph second hand 324 cannot be rotated.

In reference to Fig. 4, Fig. 31 and Fig. 32, in a reset state in which the reset button 308 is depressed in the direction designated by the arrow mark, and the hammer transmission lever A480 is rotated in the counterclockwise direction, a stop lever contact portion 480a of the hammer transmission lever A480 depresses the stop lever body 452. Therefore, the stop lever body 452 is rotated in the counterclockwise direction and the restricting portion 452c of the stop lever body 452 is separated from the stop lever plate 322f. Therefore, under the state,

the second chronograph shaft 322c is not restricted.

(9-4) A constitution and operation of the hammer

In reference to Fig. 1 through Fig. 3 and Fig. 33 through Fig. 35, the hammer transmission lever A480 includes the stop lever contact portion 480a, an operating cam contact portion 480b and a hammer transmission lever operating pin 480c. The hammer transmission lever A480 is rotatably provided centering on a hammer transmission lever A rotating shaft 480k. The hammer transmission lever B482 includes a hammer transmission lever operating hole 482a and a hammer operating portion 482c. The hammer transmission lever B482 is rotatably provided centering on a hammer transmission lever B rotating shaft 482k. A portion of the hammer transmission lever operating pin 480c is arranged in the hammer transmission lever operating hole 482a. A hammer transmission lever guide hole 480h is provided at the chronograph main plate 302. A portion of the hammer transmission lever operating pin 480c is arranged in the hammer transmission lever guide hole 480h.

The hammer 464 includes a hammer operating pin 464a, a hammer guide hole 464b, a hammer guide portion 464c, an hour heart cam contact portion 464d, a second heart cam contact portion 464e and a minute heart cam contact portion 464f. A hammer guide pin A464h and a hammer guide pin B464j are provided at the chronograph main plate 302. The hammer operating pin 464a is arranged in the hammer operating portion 482c. The hammer guide

pin A464h is arranged in the hammer guide hole 464b. The hammer guide pin B464j is arranged in the hammer guide portion 464c. The hammer 464 is movably provided by being guided by the hammer guide pin A464h and the hammer guide pin B464j.

In reference to Fig. 33, the hammer transmission lever spring portion 418c of the click spring 418 presses the hammer transmission lever operating pin 480c of the hammer transmission lever A480 such that the hammer transmission lever A480 is rotated in the clockwise direction by constituting the rotational center by the hammer transmission lever A rotating shaft 480k.

In the state of operating to measure chronograph and the state of stopping to measure chronograph, the hour heart cam contact portion 464d is separated from the hour heart cam 332d, the second heart cam contact portion 464e is separated from the second heart cam 322d and the minute heart cam contact portion 464f is separated from the minute heart cam 342d.

In reference to Fig. 1, a rotational center of the operating cam 420 is disposed in the "3 o'clock 6 o'clock region". A rotational center of the operating lever A412 is disposed in the "12 o'clock 3 o'clock region". A rotational center of the coupling lever A444 is disposed in the "3 o'clock 6 o'clock region". A rotational center of the hour/minute coupling lever 442 is disposed in the "6 o'clock 9 o'clock region". A rotational center of the hammer transmission lever A480 is disposed in the "3 o'clock 6 o'clock region". A rotational center of the hammer

transmission lever B482 is disposed in the "6 o'clock 9 o'clock region". The hammer 464 is disposed in the "6 o'clock 9 o'clock region".

In reference to Fig. 4, Fig. 34 and Fig. 35, in the reset state in which the reset button 308 is depressed in the direction designated by the arrow mark and the hammer transmission lever A480 is rotated in the counterclockwise direction, the operating cam contact portion 480b of the hammer transmission lever A480 is disposed in the valley portion 422u of the drive teeth 422 of the operating cam 420. By moving the hammer transmission lever operating pin 480c of the hammer transmission lever A480, the hammer transmission lever B482 is rotated in the clockwise direction centering on the hammer transmission lever B rotating shaft 482k.

By moving the hammer operating portion 482c of the hammer transmission lever B482, a force is exerted to the hammer operating pin 464a. Therefore, the hammer 464 is linearly moved to the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d by being guided by the hammer guide pin A464h and the hammer guide pin B464j. Further, the hour heart cam contact portion 464d is brought into contact with the hour heart cam 332d, the second heart cam contact portion 464e is brought into contact with the second heart cam 322d and the minute heart cam contact portion 464f is brought into contact with the minute heart cam 342d. Therefore, by operating the reset button

308, the hour heart cam 332d and the second heart cam 322d and the minute heart cam 342d can be zeroed. Under the state, all of the chronograph hour hand 338, the chronograph minute hand 348 and the chronograph second hand 324 indicate "zero positions" (refer to Fig. 15).

When the hammer 464 is brought into contact with the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d, the position of the hammer 464 is constituted to determine only by the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d. That is, the position of the hammer 464 is constituted to be subjected to "self alignment" by the three heart cams.

A clearance is provided between the hammer guide hole 464b of the hammer 464 and the hammer guide pin A464h. The clearance when the hammer 464 is brought into contact with the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d is constituted to be larger than the clearance when the hammer 464 is guided by the hammer guide pin A464h and the hammer guide pin B464j.

A clearance is provided between the hammer guide portion 464c of the hammer 464 and the hammer guide pin B464j. The clearance when the hammer 464 is brought into contact with the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d is constituted to be larger than the clearance when the hammer 464 is guided by the hammer guide pin A464h and

the hammer guide pin B464j.

By the constitution, when the hammer 464 is brought into contact with the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d, the position of the hammer 464 is firmly determined by the three heart cams. That is, the position of the hammer 464 is subjected to "self alignment" by the three heart cams.

In reference to Fig. 33 and Fig. 34, it is preferable that the hour heart cam contact portion 464d and the second heart cam contact portion 464e are constituted to be in parallel with each other. It is preferable that an angle made by the hour heart cam contact portion 464d and the second heart cam contact portion 464e is constituted to equal to or smaller than 10 degrees.

An angle DTF made by the hour heart cam contact portion 464d and the minute heart cam contact portion 464f is preferably constituted to be 80 degrees through 100 degrees and further preferably, right angle (90 degrees). By the constitution, the hammer 464 can firmly and simultaneously zero (return) the hour heart cam 332d and the minute heart cam 342d.

It is preferable that an angle DLT made by a direction of moving the hammer 464 to the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d by being guided by the hammer guide pin A464h and the hammer guide pin B464j relative to the hour heart cam contact portion 464d falls in a range of 30 degrees through 60 degrees. A stroke of operating



the hammer 464 is minimized when DLT is 45 degrees. Therefore, it is particularly preferable that the angle DLT is 45 degrees. By the constitution, the hammer 464 can firmly zero the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d. It is further preferable that the angle DLT is 45 degrees. By the constitution, the hammer 464 can further firmly zero (return) the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d.

When the reset button 308 is depressed in the direction designated by the arrow mark and the hammer 464 is brought into contact with the hour heart cam 332d, the second heart cam 322d and the minute heart cam 342d, the angle DLC made by the direction of the force applied to the hammer operating pin 464a relative to the second heart cam contact portion 464e of the hammer 464 is preferably 57 degrees through 84 degrees and further preferably 63 degrees through 82 degrees. When operation of the hammer 464 is analyzed in details, the force exerted to the hour heart cam 332d by the hammer 464, the force exerted to the second heart cam 322d by the hammer 464 and the force exerted to the minute heart cam 342d by the hammer 464 become the same value when the angle DLC is 63.4 degrees. In consideration of weight ratios, movements of inertia and the like of the indicators, a ratio of the force exerted to the hour heart cam 332d by the hammer 464 as well as the force exerted to the minute heart cam 342d by the hammer 464 as compared with the force exerted to

the second heart cam 322d by the hammer 464 becomes 1:5 when the angle DLC is 81.85 degrees. Therefore, it is particularly preferable that the angle DLC falls in a range of 63 degrees through 82 degrees.

The force exerted to the hammer operating pin 464a provided at the hammer 464 by the click spring 418 via the hammer transmission lever B482 is designated by notation  $F$  (refer to Fig. 34). The force exerted to the second heart cam 322d by the hammer 464 becomes smaller than  $0.3F$  when the angle DLC is 57.2 degrees. Further, the force exerted to the hour heart cam 332d by the hammer 464 as well as the force exerted to the minute heart cam 342d by the hammer 464 becomes shorter than  $0.1F$  when the angle DLC is 84.2 degrees. Therefore, it is preferable that the angle DLC falls in a range of 57 degrees through 84 degrees.

By the constitution, the force of bringing the hammer 464 into contact with the hour heart cam 332d, the force of bringing the hammer 464 into contact with the second heart cam 322d and the force of bringing the hammer 464 into contact with the minute heart cam 342d can be constituted to be uniform.

(10) An explanation of operation of a chronograph timepiece

In reference to Fig. 15, in a state of not operating the chronograph mechanism, the hour hand 368 indicates "hour" in current time, the minute hand 364 indicates "minute" in current time, and the second hand 354 (small second hand) indicates "second" in current time. The chronograph timepiece shown in

Fig. 15 indicates time at an interval between "10 o'clock 8 minute 12 second" and "10 o'clock 8 minute 13 second". Under the state, the chronograph hour hand 338 is stopped at a position indicating "12", the chronograph minute hand 348 is stopped at a position indicating "30" and the chronograph second hand 324 is stopped at a position indicating the 12 o'clock direction of the timepiece, that is, "60".

The chronograph second hand 324 is constituted to rotate by 1 rotation per 1 minute. Chronograph second graduations in correspondence with the chronograph second hand 324 are provided as "5", "10", "15" ... "50", "55" and "60" along the outer periphery of the timepiece, that is, along a rotational locus of a front end of the chronograph second hand 324.

As an example, an embodiment of a chronograph timepiece of the invention is constituted to be a timepiece of, so-to-speak "8 oscillation". "8 oscillation" indicates a constitution in which a balance with hairspring is oscillated by 28800 oscillations in 1 hour. Here, "oscillation" indicates a state of rotating the balance with hairspring in one direction and the balance with hairspring returns to the original position by "2" oscillations. That is, in the case of the timepiece of "8 oscillation", the balance with hairspring is oscillated by 8 oscillations in 1 second and oscillated to make 4 reciprocations in 1 second. The chronograph timepiece may be constituted to be a timepiece of so-to-speak "10 oscillation". "10

oscillation" indicates a constitution in which the balance with hairspring is oscillated by 36000 oscillations in 1 hour. According to a timepiece of "10 oscillation", the balance with hairspring is oscillated by 10 oscillations in 1 second and oscillated to make 5 reciprocations in 1 second. By constituting in this way, there can be realized a chronograph timepiece capable of measuring chronograph by a unit of "1/10 second".

According to the constitution, a graduation of chronograph second may be provided for each "1/10 second" or the graduation of chronograph second may be provided at each "1/5 second". By constituting in this way, the chronograph timepiece having high accuracy can be realized. The chronograph timepiece may be constituted to be a timepiece of so-to-speak "5.5 oscillation" or "6 oscillation". According to the constitutions, the graduation of the chronograph second is set in accordance with the number of oscillations and also a number of teeth of the train wheel is set in accordance with the number of oscillations.

The chronograph minute hand 348 is constituted to rotate by 1 rotation in 30 minutes. Graduations of chronograph minute in correspondence with the chronograph minute hand 348 are set such as "5", "10", "15", "20", "25" and "30" along a rotational locus of a front end of the chronograph minute hand 348. The chronograph minute hand 348 may be constituted to rotate by 1 rotation in 60 minutes.

The chronograph hour hand 338 is constituted to rotate

by 1 rotation in 12 hours. Graduations of chronograph hour in correspondence with the chronograph hour hand 338 are set such as "1", "2", "3" ... "11" and "12" along a rotational locus of a front end of the chronograph hour hand 338. The chronograph hour hand 338 may be constituted to rotate by 1 rotation in 24 hours.

A date character of the date indicator 376 indicates current date. The chronograph timepiece shown in Fig. 15 indicates "5". Although in Fig. 15, there is shown a structure in which the position of the date window is disposed at middle of the "4 o'clock direction" and the "5 o'clock direction" of the movement, the position of the date window can be arranged in the "12 o'clock direction" of the movement or can be arranged at other position of "1 o'clock direction", "8 o'clock direction" or the like.

According to the chronograph timepiece of the invention, the rotational center of the hour hand 368, the rotational center of the minute hand 364 and the rotational center of the chronograph second hand 324 are arranged substantially at the center of the timepiece, the rotational center of the second hand 354 (small second hand) is arranged on the 3 o'clock side of the timepiece, the rotational center of the chronograph minute hand 348 is arranged on the 9 o'clock side of the timepiece and the rotational center of the chronograph hour hand 338 is arranged on the 6 o'clock side of the timepiece. Therefore, according to the

chronograph timepiece of the invention, indication of the respective indicators is very easy to understand.

In reference to Fig. 15 and Fig. 26, chronograph can be started to measure by depressing the start/stop button 306 disposed in the 2 o'clock direction of the chronograph timepiece. That is, when the start/stop button 306 is depressed, the operating lever A412 and the operating lever B416 are operated, the ratchet teeth 424 of the operating cam 420 are fed by 1 tooth and the operating cam 420 is rotated. When the operating cam 420 is rotated, the coupling lever A444 and the coupling lever B446 are separated from the intermediate second chronograph wheel clutch ring 320d, the hour/minute coupling lever 442 is separated from the intermediate hour chronograph wheel clutch ring 332h and the intermediate minute chronograph wheel clutch ring 342h to make clutch ON. As a result, the second chronograph wheel shaft 322c is rotated, the minute chronograph wheel shaft 342c is rotated and the hour chronograph wheel shaft 332c is rotated. As a result, the chronograph second hand 324 indicates "second" of a result of measuring chronograph, the chronograph minute hand 348 indicates "minute" of the result of measuring chronograph and the chronograph hour hand 338 indicates "hour" of the result of measuring chronograph.

Next, when the start/stop button 306 is depressed by one more time, the chronograph timepiece can be stopped to measure. That is, when the start/stop button 306 is depressed by one more

time, the operating lever A412 and the operating lever B416 are operated to feed the ratchet teeth 424 of the operating cam 420 by 1 tooth to rotate the operating cam 420. When the operating cam 420 is rotated, the coupling lever A444 and the coupling lever 446 are brought into contact with the intermediate second chronograph wheel clutch ring 320d, the hour/minute coupling lever 442 is brought into contact with the intermediate hour chronograph wheel clutch ring 332h and the intermediate minute chronograph wheel clutch ring 342h to make clutch OFF. Further, the operating cam 420 operates the stop lever 440 and the stop lever 440 restricts the stop lever plate 322 of the second chronograph wheel 322. As a result, rotation of the second chronograph wheel shaft 322c is stopped, rotation of the minute chronograph wheel shaft 342c is stopped and rotation of the hour chronograph wheel shaft 332c is stopped. As a result, the chronograph second hand 324 is stopped to indicate "second" of the result of measuring chronograph, the chronograph minute hand 348 is stopped to indicate "minute" of the result of measuring chronograph and the chronograph hour hand 338 is stopped to indicate "hour" of the result of measuring chronograph.

Under the state, when the start/stop button 306 is depressed by one more time, chronograph can be restarted to measure from the state of stopping to measure chronograph.

In reference to Fig. 15 and Fig. 35, in the state of stopping to measure chronograph, when the reset button 308 is depressed,

the chronograph second hand 324, the chronograph minute hand 348 and the chronograph hour hand 338 are returned to stop at "zero positions" before starting to operate the chronograph mechanism. That is, when the reset button 308 is depressed, the hammer transmission lever A480, the hammer transmission lever B482 and the hammer 464 are operated. Further, the hammer transmission lever A480 rotates the stop lever 440, the restricting portion 452c of the stop lever body 452 is separated from the stop lever plate 322f to make the second chronograph wheel 322 in a free state. Further, the hammer 464 rotates the second heart cam 322d, rotates the minute heart cam 342d and rotates the hour heart cam 332d to zero the chronograph second hand 324, the chronograph minute hand 348 and the chronograph hour hand 338 to "zero positions".

Even in measuring chronograph, or in the state of stopping to measure chronograph, the hour hand 368 indicates "hour" in current time, the minute hand 364 indicates "minute" in current time and the second hand 354 indicates "second" in current time.

In reference to Fig. 5, Fig. 6 and Fig. 15, the winding stem 108 can be pulled out by pulling out a crown 390. Date can be corrected by pulling out the winding stem 108 to 1 stage and rotating the winding stem 108 by rotating the crown 390. Time can be corrected by pulling out the winding stem 108 to 2 stage and rotating the winding stem 108 by rotating the crown 390.



The chronograph timepiece of the invention is constituted by a structure in which the chronograph mechanism and the calendar mechanism do not overlap each other and by the invention, a thin type chronograph timepiece can be realized.

According to the chronograph timepiece of the invention, the surface train wheel is not provided with a clutch mechanism and therefore, the structure of the chronograph train wheel is simple and a number of parts is small.

According to the chronograph timepiece of the invention, the structure of the lever constituting the chronograph mechanism is simple and a number of parts is small.

According to the chronograph timepiece of the invention, fabrication and assembly of the chronograph mechanism are facilitated.